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PATENT #5

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Kunzel		
Serial No.	:	10/005,561	Examiner:	To Be Assigned
Filed	:	December 4, 2001	Group Art Unit:	3682
For	:	METHOD AND CONTROL STRUCTURE FOR DAMPING LOW-FREQUENCY LOAD OSCILLATIONS IN DRIVES WITH A MOTOR AND LOAD		

PRELIMINARY AMENDMENT

I hereby certify that this paper is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231

Bradley B. Geist	27,551
Attorney Name	PTO Registration No
	April 9, 2002
Signature	Date of Signature

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

Please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please amend paragraph [0001] on page 1 to read as follows:

--The invention relates to a method and a control structure for damping low-frequency load oscillations in drives with a motor and load, the motor having a motor-speed controller, and the load having a load-speed controller.—

On page 8, paragraph [0022] should read as follows:

--In FIGURE 4, a motor-speed setpoint value (z) of a motor-speed controller 9 which is subject to high-speed control and which is superimposed on the current controller 1 illustrated in FIGURE 4 is used as the connection point. The embodiment of the motor-speed controller 9 as a PI controller is not essential and other controllers may be used. The motor-speed controller 9 can, if it is a low-frequency load oscillation, always be quickly set. This is due to the fact that, in addition to the oscillation poles of the load oscillation, a conjugate complex zero position pair with a relatively low frequency occurs in the controlled system. Therefore, provided that the other small constants of the system and controller cause a negligible phase rotation in the oscillation frequency, the oscillation can easily be damped for the motor-speed controller 9. For this reason, the present invention can preferably be applied to low-frequency load oscillations. High-frequency load oscillations are generally not as disruptive.—

Paragraph [0023] on page 9, should read as follows:

--For the motor-speed controller, the motor-speed actual value (c) is subtracted from the motor-speed setpoint value (z) in a connection point 9" and fed to the motor-speed controller 9. The load-speed controller 10, having combined components are illustrated by a dotted line, predefines the motor-speed setpoint value which is formed in the summation point 9'. Here, the filtered load acceleration (i) multiplied by an adjustable factor is included as well as the pilot control value 12, and a limited proportional component 10" of the load-speed controller 10, which is formed from the -speed setpoint value (x) minus the load-

speed actual value (g) in the summation point 10', is subjected to the proportional amplification in 10" and limited with the limiter 11.—

Please amend paragraph [0025] on page 10, as follows:

--In order to change the transient response time, according to the present invention the difference between the setpoint speed and load speed is connected to the motor-speed setpoint value after multiplication by a further adjustable factor 10". In order to avoid a controlled-system wind-up, this connection value is also limited in a limitation 11 which follows the load-speed controller 10". Because the motor speed (c) and the load speed (g) are the same in steady-state terms, a pilot control 12 of the load-speed setpoint value (x) past the load-speed controller 10" with limitation 11 to the motor-speed controller 9 is provided as a supplement.—

<u>IN THE DRAWINGS</u>:

Please make the changes to "FIG 4" as indicated in red ink.

<u>IN THE CLAIMS</u>:

Please amend claims 1, 2, 6-20 and 22 to read as follows:

1. (Amended) A method for damping low-frequency load oscillations in drives having a motor and load a motor-speed control and a load-speed control comprising damping only in the load-speed control.

2. (Amended) The method according to claim 1, wherein load-acceleration is connected to an input-end motor-speed setpoint value of the motor-speed control.

6. (Amended) The method according to claim 2, wherein a difference value formed from the speed setpoint value and the load speed is connected to the input-end motor-speed setpoint value of the motor-speed control.

7. (Amended) The method according to claim 6, wherein the difference value for the load-speed control is limited before the connection to the motor-speed setpoint value.

8. (Amended) The method according to claim 6, further comprising performing a pilot control of a load-speed setpoint value past the load-speed control to the motor-speed control.

9. (Amended) The method according to claim 1, wherein the load-speed control has at least one proportional and/or one differential control component.

10. (Amended) The method according to claim 1, wherein a load position control takes place above the load-speed control.

11. (Amended) The method according to claim 2, wherein the load acceleration is filtered with a filter before connection to an input-end motor-speed setpoint value of the motor-speed control.

12. (Amended) A cascade control structure for damping low-frequency load oscillations in drives having a motor and load, comprising a subordinate motor-speed control and a superordinate load-speed control.

13. (Amended) The cascade control structure according to claim 12, wherein a load acceleration is connected to the motor-speed control at the input end is used for damping.

14. (Amended) The cascade controller structure according to claim 12, wherein the load-speed control is implemented by input-end connection of a difference formed from a speed setpoint value and load speed value to the motor-speed control.

15. (Amended) The cascade controller structure according to claim 14, wherein a means for multiplying the difference formed from the speed setpoint value and load speed value is provided before the connection to the motor-speed control.

16. (Amended) The cascade controller structure according to claim 14, wherein a means for limiting the difference formed from the speed setpoint value and load speed value is provided before the connection to the motor-speed control.

17. (Amended) The cascade controller structure according to claim 12, further comprising providing a pilot control of a load-speed setpoint value past the load-speed control to the motor-speed control.

18. (Amended) The cascade controller structure according to claim 12, wherein the load-speed controller has at least one proportional and/or one differential control component.

19. (Amended) The cascade controller structure according to claim 12, wherein a load position controller is arranged above the load-speed control.

20. (Amended) The cascade controller structure according to claim 13, wherein a filter unit is provided for filtering the load acceleration which is connected to the motor speed control at the input end.

22. (Amended) The method according to claim 6, wherein the load speed is multiplied by a predefined factor.

IN THE ABSTRACT:

Please amend the Abstract to read as follows:

--According to the invention, the controller cascades are suitably divided up and the oscillation damped only in the load-speed controller. Here, a motor-speed setpoint value (z) of a quickly regulated motor-speed controller (9) and not the motor torque, is selected as the connection point for a load acceleration (i). In order to achieve a shorter transient response time, according the invention the difference between a setpoint speed (x) and load speed (y) is connected to the motor-speed setpoint value (z). The solution in principle according to the invention which is presented has, in contrast to other known methods, the advantage that the actuation of the corresponding controllers is comparatively simple with very good control results.--

REMARKS

Applicant respectfully requests that the foregoing amendments be entered. No new matter has been added to the application.

The amendments to the Specification, Claims and Abstract are reflected in the attached "Version With Marked Changes Made."

Respectfully submitted,

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Enclosure

Version With Marked Changes Made

In the Specification:

The invention relates to a method and a control structure for damping low-frequency load oscillations in drives with a motor and load, the motor having a motor~~-rotational~~-speed controller, and the load having a load-~~rotational~~-speed controller.

In FIGURE ~~3,~~4, a motor~~-rotational~~-speed setpoint value (z) of a motor~~-rotational~~-speed controller 9 which is subject to high-speed control and which is superimposed on the current controller 1 illustrated in FIGURE ~~3~~4 is used as the connection point. The embodiment of the motor ~~rotational~~-speed controller 9 as a PI controller is not essential and other controllers may be used. The motor~~-rotational~~-speed controller 9 can, if it is a low-frequency load oscillation, always be quickly set. This is due to the fact that, in addition to the oscillation poles of the load oscillation, a conjugate complex zero position pair with a relatively low frequency occurs in the controlled system. Therefore, provided that the other small constants of the system and controller cause a negligible phase rotation in the oscillation frequency, the oscillation can easily be damped for the motor~~-rotational~~-speed controller 9. For this reason, the present invention can preferably be applied to low-frequency load oscillations. High-frequency load oscillations are generally not as disruptive.

For the motor~~-rotational~~-speed controller, the motor~~-rotational~~-speed actual value ~~©~~(c) is subtracted from the motor~~-rotational~~-speed setpoint value (z) in a connection point 9" and fed to the motor~~-rotational~~-speed controller 9. The load~~-rotational~~-speed controller 10, having combined components are illustrated by a dotted line, predefines the motor~~-rotational~~-speed

setpoint value which is formed in the summation point 9'. Here, the filtered load acceleration (i) multiplied by an adjustable factor is included as well as the pilot control value 12, and a limited proportional component 10" of the load~~-rotational~~-speed controller 10, which is formed from the ~~rotational~~-speed setpoint value (x) minus the load~~-rotational~~-speed actual value (g) in the summation point 10', is subjected to the proportional amplification in 10" and limited with the limiter 11.

In order to change the transient response time, according to the present invention the difference between the setpoint~~-rotational~~ speed and load~~-rotational~~ speed is connected to the motor ~~rotational~~-speed setpoint value after multiplication by a further adjustable factor ~~10.~~10". In order to avoid a controlled-system wind-up, this connection value is also limited in a limitation 11 which follows the load~~-rotational~~-speed controller ~~10.~~10". Because the motor~~-rotational~~ speed ~~©~~(c) and the load~~-rotational~~ speed (g) are the same in steady-state terms, a pilot control 12 of the load~~-rotational~~-speed setpoint value (x) past the load~~-rotational~~-speed controller 10" with limitation 11 to the motor~~-rotational~~-speed controller 9 is provided as a supplement.

In the Claims:

1. (Amended) A method for damping low-frequency load oscillations in drives having a motor and load a motor~~-rotational~~-speed control and a load~~-rotational~~-speed ~~controll~~control comprising damping only in the load~~-rotational~~-speed control.

2. <ins>(Amended)</ins> The method according to claim 1, wherein load-acceleration is connected to an input-end motor~~-rotational~~-speed setpoint value of the motor~~-rotational~~-speed control.

6. <ins>(Amended)</ins> The method according to claim 2, wherein a difference value formed from the ~~rotational~~-speed setpoint value and the load ~~rotational~~-speed is connected to the input-end motor~~-rotational~~-speed setpoint value of the motor~~-rotational~~-speed control.

7. <ins>(Amended)</ins> The method according to claim 6, wherein the difference value for the load~~-rotational~~-speed control is limited before the connection to the motor~~-rotational~~-speed setpoint value.

8. <ins>(Amended)</ins> The method according to claim 6, further comprising performing a pilot control of a load~~-rotational~~-speed setpoint value past the load~~-rotational~~-speed control to the motor~~-rotational~~-speed control.

9. <ins>(Amended)</ins> The method according to claim 1, wherein the load~~-rotational~~-speed control has at least one proportional and/or one differential control component.

10. <ins>(Amended)</ins> The method according to claim 1, wherein a load position control takes place above the load~~-rotational~~-speed control.

11. <ins>(Amended)</ins> The method according to claim 2, wherein the load acceleration is filtered with a filter before connection to an input-end motor~~-rotational~~-speed setpoint value of the motor~~-rotational~~-speed control.

12. <u>(Amended)</u> A cascade control structure for damping low-frequency load oscillations in drives having a motor and load, comprising a subordinate motor-~~rotational~~-speed control and a superordinate load-~~rotational~~-speed control.

13. <u>(Amended)</u> The cascade control structure according to claim 12, wherein a load acceleration is connected to the motor-~~rotational~~-speed control at the input end is used for damping.

14. <u>(Amended)</u> The cascade controller structure according to claim 12, wherein the load-~~rotational~~-speed control is implemented by input-end connection of a difference formed from a ~~rotational-~~speed setpoint value and load ~~rotational-~~speed value to the motor-~~rotational~~-speed control.

15. <u>(Amended)</u> The cascade controller structure according to claim 14, wherein a means for multiplying the difference formed from the ~~rotational-~~speed setpoint value and load ~~rotational-~~speed value is provided before the connection to the motor-~~rotational~~-speed control.

16. <u>(Amended)</u> The cascade controller structure according to claim 14, wherein a means for limiting the difference formed from the ~~rotational-~~speed setpoint value and load ~~rotational-~~speed value is provided before the connection to the motor-~~rotational~~-speed control.

17. <u>(Amended)</u> The cascade controller structure according to claim 12, further comprising providing a pilot control of a load-~~rotational~~-speed setpoint value past the load ~~rotational~~ -speed control to the motor-~~rotational~~-speed control.

18. (Amended) The cascade controller structure according to claim 12, wherein the load~~-rotational-~~-speed controller has at least one proportional and/or one differential control component.

19. (Amended) The cascade controller structure according to claim 12, wherein a load position controller is arranged above the load~~-rotational~~-speed control.

20. (Amended) The cascade controller structure according to claim 13, wherein a filter unit is provided for filtering the load acceleration which is connected to the motor ~~rotational-~~speed control at the input end.

~~22.~~ 22. (Amended) The method according to claim 6, wherein the load~~-rotational~~ speed is multiplied by a predefined factor.

In the Abstract:

According to the invention, the controller cascades are suitably divided up and the oscillation damped only in the load~~-rotational~~-speed controller. Here, a motor~~-rotational~~-speed setpoint value (z) of a quickly regulated motor~~-rotational~~-speed controller (9) and not the motor torque, is selected as the connection point for a load acceleration (i). In order to achieve a shorter transient response time, according the invention the difference between a setpoint ~~rotational-~~speed (x) and load ~~rotational-~~speed (y) is connected to the motor~~-rotational~~-speed setpoint value (z). The solution in principle according to the invention which is presented has, in contrast to other known methods, the advantage that the actuation of the corresponding controllers is comparatively simple with very good control results.